



Fig. 1. This 1906 photograph is believed to be the first one taken of a black-footed ferret (New York Zoological Society photo).

pecially when compared to the species-rich countries of the developing world. In the United States, an endangered species might expect attention from layers of interested parties: the federal government, state government, private nongovernmental organizations including universities, and, of course, individuals. Such infrastructure is rarely present in the Third World, and so WiCI concentrates its efforts there, conducting and supporting research on the biology of endangered species. We call it conservation biology, and, at any given moment, we will have 30 or so projects underway.

However, since the founding of NYZS in 1895, the society has never entirely divorced itself from species conservation in the United States. In the early part of this century, the vociferous contributions of William Hornaday, the first director of NYZS, to shaping the U.S. Fish and Wildlife Service, its refuge system, and the early laws entrusted to it succeeded in leaving a permanent NYZS imprint on American wildlife conservation. The society also takes considerable pride in having played a central role in restoring the American bison to the western plains between 1905 and 1919. In conjunction with the federal government, remnant groups of bison were gathered at the society's Bronx Zoo, in New York.

Stocks from the combined herd were sent by rail to such protected areas as the Wichita Mountains Wildlife Refuge.

Among the studies sponsored by NYZS in this country is one of particular relevance to the present monograph. It is Carl Koford's work with prairie dogs, appearing in 1958 as "Prairie Dogs, White Faces and Blue Grama" in the journal *Wildlife Monographs*. Koford's was the first major technical paper to show a tie between prairie dog eradication and ferret decline. It was a deadly tie indeed.

The society was helpful to Koford's prescient research and now finds itself back in the West, again with the ferrets, this time promoting science appropriate to recovery. Despite our current commitment to conservation biology abroad, the society's affection for wildlife of the West is clear. In fact the attachment is symbolized in the logo of NYZS, a bust of the bighorn sheep.

In the fall of 1981 the U.S. Fish and Wildlife Service's *Endangered Species Technical Bulletin* announced the discovery of a black-footed ferret colony near Meeteetse, Wyoming. It was electrifying news, and a host of American conservation groups perked up, looking for ways to lend a hand. Just about every one had accepted the USFWS bitter decision three years prior to consider the fer-

ret extinct. Everyone, that is, except for a very few individuals who kept searching throughout those bleak years.

A shaggy ranch dog turned things around. It's true, the dog killed the only ferret anyone had seen in years, but the single specimen, probably a wayfaring yearling from the colony, was tangible evidence that a whole species still lived.

I confess, I don't mind defending the dog. I met him once. His name is Shep. He is very tractable, and blithely unconcerned with the hoopla stirred up by his routine vigilance.

Following the *Bulletin's* report of the ferret find, Wildlife Conservation International made the decision to become involved in the species' recovery. We were influenced by three considerations:

1. Without doubt—and without apology—we saw public-relations value in taking a leadership role in the potential restoration of this highly publicized American species. A good job with the little ferret would help us in the chronic task of raising funds for other species. The ferret might have become a mini-panda, valuable to our image making. And so, we dominated the private funding picture from 1982 to 1985.

2. Secondly, there was the political situation, to which I have alluded before. In the view of most conservationists in late 1981, the Endangered Species Act was in jeopardy, and consequently the ability of the federal government to respond constructively to the ferret find was predicted to be limited. The times were chaotic for wildlife conservation. Already that autumn I had joined a letter-writing campaign to halt dismantling of USFWS Cooperative Wildlife Research Units at universities all over the country. The Endangered Species Office budget had been slashed. The secretary of interior had declared that his department would list no more endangered species, just as it would gazette no new national parks. It was a tough time to arise from the dust of extinction, and we at WiCI felt that if we didn't make a move to help the ferret, the little beast might actually slip back into oblivion. It's expected savior, Uncle Sam, was hobbled by an anomalous secretary of the interior.

- 3) Our third motivation for entering ferret history was a practical one. After reading the

first reports that the ferret colony might consist of a couple of dozen breeding animals, we were very certain that captive breeding and establishment of new colonies would be recommended. That form of animal management has attained a high degree of sophistication at the Bronx Zoo, the sister organization to WiCI in the New York Zoological Society. The cadre of NYZS people involved in captive breeding of wildlife, from curators to veterinarians, is large and skilled, and we planned to make it clear to all concerned that we were ready to contribute when the time came.

With these circumstances in mind, we set about to find an outlet for our good will, talent, and cash. At precisely the same moment, one Dr. Tim Clark began inquiring of possible WiCI interest in granting support for his ferret studies. His field work—counts, feeding behavior, reproduction studies—were precisely the type of biology favored by WiCI, and his commitment to working in conjunction with the complex federal-state mechanism reassured us that our sponsorship would go toward an influential project. We began work with Tim Clark and his Biota Research and Consulting, Inc. in 1982.

Largely through Dr. Clark's initiatives, the ferrets attracted the attention of numerous other conservation organizations, most of whom assisted Clark's project directly. These included the World Wildlife Fund—U.S., the National Geographic Society, the National Wildlife Federation, and the Charles A. Lindbergh Fund. Aside from contributing cash, several of these prominent nongovernmental organizations assumed lobbying tasks in Washington in support of the ferret. But Dr. Clark's first support—given even before the ferrets were discovered, and sustained, one presumes, out of blind faith that some animals must have remained somewhere in the vastness of the West—came from the little-known Wildlife Preservation Trust International (WPTI). WPTI is an American-based offshoot of the Jersey Wildlife Preservation Trust, an institution given prominence by Gerald Durrell, director of the famous Jersey Zoo in England.

A discernible recovery program began to take shape in Wyoming. The one known colony was secured, thanks in large part to the unusual cooperation of the owners of the only

inhabited ferret land. Research was begun promptly and was pursued with vigor, to the extent that, as the papers contained herein and others reveal, we quickly learned the size of the single colony, its demographics, and that possibly "surplus" youngsters were available every fall as potential candidates for captive breeding or translocation. We learned how to search for ferrets, and, tragically, that over tremendous areas of potential habitat there were no more ferrets. The American conservation community rallied effectively to underwrite the bulk of the research to the tune, cumulatively, of over \$550,000, according to a recent manuscript by Tim Clark. In the final analysis, cooperation in the field between government and nongovernmental agencies was satisfactory. To help enhance this atmosphere of cooperation, the Black-footed Ferret Advisory Team (BFAT) was put together, a sort of clearing house for the growing interest in black-footed ferrets.

I became optimistic. I thought I sensed a surge of enthusiasm among ferret people, a threshold of determination that, once crossed, would overwhelm whatever obstacles might be thrown up by the Watt administration.

In April 1982 I saw a ferret and was inspired even more. I flew out to Cody, Wyoming, with Jim Doherty, the seasoned curator of mammals for the New York Zoological Society. I was anxious for Jim to accompany me because already we were certain that captive breeding of ferrets would become a recovery priority, and Jim could represent the society's expertise in this field.

We drove south to Meeteetse and joined Tim Clark and his research associates Tom Campbell, Louise Richardson, and Steve Forrest. They were the principal figures in the field program and they introduced us to the research. Later I wrote about the outing in our newsletter, *the Ferret*, first published shortly after WiCI joined forces with Tim and his colleagues:

After a day with Tim Clark, exploring the prairie dog colony where the ferrets clung to their tenuous future, . . . Jim Doherty and I joined ferret biologist Tom Campbell for a unique adventure. Driving in a pickup truck along a graded road near the prairie dogs in the dead of night, we saw a black-footed ferret. We were lucky.

Only nine individuals had been found by spotlighting since Clark and Campbell had begun their surveys back before Christmas. Our ferret came bounding across the prairie in its odd, accelerated inch-worm gait and wound up in a prairie dog den twenty feet from the right fender of the truck. We feasted on the view for many excited minutes.

The ferret was as high strung and energetic a creature as I had ever seen. It fairly crackled with nervous impulses, first digging, then stretching to stare, then circling the den, then looping back in. I was moved by the idea that if we humans would give the ferret half a chance, that purposeful dynamo would surely do the rest.

It was a nice sentiment at the time. It seems naive now, because that "half a chance" was never granted.

Time passed. The field work continued. Searches for ferrets were begun in other states. Litters of ferrets were recorded at Meeteetse. Data were published. Letters were written. No progress was made toward captive breeding during 1982 and 1983.

Finally, at the request of the nongovernmental conservation community, a meeting was called by the Wyoming Game and Fish Department in the spring of 1984 in Cheyenne. Jim Doherty and I were invited to participate. The meeting would include field biologists, veterinarians, and administrators representing federal, state, and private agencies, essentially the extended network of people responsible for the survival of the black-footed ferret.

Sure enough, captive management became the focus of the meeting just as soon as the introductory material was set aside. Tim Clark and his colleagues presented enough demographic data to suggest that the Meeteetse ferret colony was stable or even growing. Arriving at comparable figures from year to year is difficult because census methods were evolving and improving as time went by, but the best published estimates for all years, based on early August counts of adults and young, are as follows:

1982	61 (incomplete survey)
1983	88
After this meeting:	
1984	129
1985	58

The 1983 figure and the abundance of youngsters every fall relative to the number of adults, were strong indications that ferrets

could be captured without jeopardizing the Meeteetse colony. Thinking back to that large gathering in Cheyenne, I recall a universal consensus that establishment of one or more captive colonies was of utmost urgency. The chief justifications were (a) to provide a strategic cushion in the event a disease—an epizootic—struck the little Meeteetse population and (b) to provide, in the course of time, the stock for recolonization of suitable ferret habitat. It was sound, if belated, reasoning. The only dissention came in deciding how to do it.

As early as 1981 the U.S. Fish and Wildlife Service had granted Wyoming Game and Fish Department "lead agency" status for ferret recovery, a legal courtesy permitted under the Endangered Species Act. Thus, Wyoming Game and Fish had begun to organize activities, helping foster BFAT, convening the Cheyenne meeting, and generally assuming responsibility for major decisions. Assumption of leadership by a state agency in this manner had precedent elsewhere; and, in cases where the federally protected species is limited in distribution, it seems a logical way to implement the act. Provided the surrogate agency responds to the federal mandate, the process is viable.

At Cheyenne we began to see the hang-up on captive breeding as an element in the survival process. State officials, while concurring with the captive propagation tactic, announced firmly that no ferrets would leave Wyoming to achieve this purpose. Simultaneously they declared that their own Sybille Canyon Wildlife Research Unit was unsatisfactory as a captive breeding facility, an ironic viewpoint as things turned out; and they concluded that federal and/or private agencies should pay for the cost of building and staffing a proper facility in Wyoming.

In view of the availability of well-equipped, well-staffed, well-funded facilities in several locations around the U.S., this pronouncement by the lead agency for ferret recovery was met with consternation by both federal and private nonprofit organization representatives. The 1984 capture season (September-October, when young of the year are weaned and dispersing) came and went, but the Cheyenne impasse prevailed despite the probabilistic certainty of the consequences.

In May of 1985 a decision was made by state and federal officers to attempt to capture ferrets in October, provided the scheduled summer counts showed an acceptable but unspecified surplus. Sybille Canyon was agreed upon as a holding facility, but no specific breeding facility was identified. Almost concurrently with the meeting, plague was reported among the white-tailed prairie dogs of Meeteetse, the prey base of the ferrets. To everyone's relief, the mustelids, evidently, were immune to plague, but there loomed the possibility of starvation for ferrets if the prairie dog die-back was too severe. As it turned out, the plague episode served chiefly as an unnerving object lesson of the principles of epizootic disease, principles that were familiar to most of us from the beginning.

During the period June-October 1985, the principles were applying themselves with mortal vigor. The July-August count gave strong indications that something was amiss, but no real credence was given the declining population figures until 22 October. By that time supplementary surveys in September had arrived at a count of 31 ferrets, one month after the August estimate of 58, and by October 9 only 13 ferrets were seen in the field.

Six ferrets had been captured by early October and brought to the Sybille Canyon Wildlife Research Unit. On 22 October one of these animals was reported dead and the cause was diagnosed as canine distemper. Wyoming Game and Fish acknowledged that the disease was "probably the worst event that could have occurred in the ferret population."

Immediately a capture team was sent to the field to capture as many of the threatened remaining ferrets as possible. Six were brought in by the following week when the capture term was withdrawn before capturing all the ferrets. Biologists departing the scene after the emergency exercise guessed that fewer than 10 remained in the Meeteetse population. Their significance to the future of the species must be regarded as negligible for the time being. Their numbers are few; they are scattered over a vast terrain; distemper is presumably still among them; and the Wyoming winter is coming on.

Now, after additional deaths in the captive group, six ferrets remain. The Sybille Six. There is no cushion. For a while the best of



American wildlife science might have governed the future of this species. Now luck is the guiding force. We need luck with the Sybille Six, that they might multiply; and we need luck out on the prairies, that some stalwart surveyor might chance upon yet another last colony of black-footed ferrets.

The black-footed ferret once enjoyed a range about as extensive as any that North America can offer, encompassing all of what we call the Great Plains and beyond. The little mustelid was the incidental victim of one of the most diligent vertebrate pest control exercises in history: the attempt to eradicate prairie dogs for the alleged benefit of livestock grazing. The assault changed prairie dog distribution dramatically. In the process it wiped out ferrets from Canada to Mexico—except for the few discovered near Meeteetse.

History should record that rational people stepped forward when the Meeteetse colony was found. Among them were the authors of the papers that follow, people who assumed

that they worked within a rational system, far different from the cavalier times that brought the ferret so near extinction in the first place. But that system, ultimately based in the U.S. Endangered Species Act, has failed the ferret. It has converted a tense but hopeful outlook for the species into a crisis. The system became impotent as decision makers locked themselves into years of indecision as to the venue for captive propagation of ferrets.

Altogether, the species has not fared well in its ecological partnership with modern man. But in every such sad story there is a lesson. The ferret story may contain two. Following its first decline, we people reviewed our use of pesticides, our fanatical reaction to agricultural “pests,” our obligation to public lands; and our general management of Great Plains land, whether private or public. I believe the message of the ferret’s second decrement is that the U.S. Endangered Species Act may no longer be the safety net for American wildlife that Congress intended it to be.

## TECHNICAL INTRODUCTION

Tim W. Clark<sup>1</sup>

ABSTRACT.—The contents of this volume and their relationship to ferret conservation and recovery are discussed.

The critically endangered black-footed ferret (*Mustela nigripes*) has been an enigma ever since its scientific discovery in 1851 by John James Audubon and John Bachman. In 1877 Dr. Elliott Coues of the Smithsonian Institution reported that the ferret was common to the plains of the West and associated with prairie dogs (*Cynomys* sp.). Collection records show that, until the first decades of this century, ferrets were distributed over about 40 million ha in 12 states and 2 Canadian provinces. By the late 1940s, no ferrets could be located for study, ostensibly because of a precipitous decline in population size and distribution, from habitat loss (the poisoning of prairie dogs), and perhaps other factors. The ferret was considered extinct or nearly so when in 1964 a small population was discovered in South Dakota and the species came under study for the first time—113 years after its scientific discovery.

Three chapters stand out in ferret study and conservation: (1) From the 1830s to 1964, during which time specimens were occasionally collected and a few natural history observations recorded; (2) from 1964 to 1981, when the Mellette County, South Dakota, ferret population was discovered and studied for 11 years (ca 90 different ferrets were observed, including 11 litters) and it dwindled to extinction. Attempts to breed a few ferrets in captivity came too late, and no other populations were discovered despite surveys. Many people feared the ferret was extinct; (3) from 1981 to date, when the Meeteetse, Wyoming, ferret population was discovered and studied (ca 129 different ferrets were seen, including 25 litters in 1984). In part, this period closes with this volume and the many other conservation

biology papers resulting from the Meeteetse studies (see Casey et al. in this monograph). All these papers describe key aspects of the Meeteetse ferret population, habitat requirements, and means of managing and recovering the species. We hope this third chapter will usher in a fourth chapter—full recovery of the species to secure, viable populations scattered over portions of its former range.

Individually and collectively, the 14 original contributions to this monograph, plus the introductory remarks by Dr. Archie Carr III, provide a much fuller understanding of the species and the foundation needed for full species recovery. Other study results on the Meeteetse ferrets have been published elsewhere, and they, too, add significantly to our understanding of the ferret and its conservation needs. To be sure, many details about ferret behavior and ecology remain to be learned, but they can wait until the ferret is more common and can accommodate rigorous scientific scrutiny in laboratory and field. These 14 papers describe numerous aspects of ferret biology, management, and recovery direction—all for the first time.

First, Anderson et al. examine the ferret's fossil record as well as recent distribution and systematics. Pleistocene and Holocene faunas ( $n=21$ ) show ferret remains. Ferret distribution based on 412 specimens in 68 museums from Arizona, Colorado, Kansas, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Texas, Utah, Wyoming, and Canada are summarized. Comparisons of Pleistocene with Recent specimens show no significant differences in size or morphology. Analysis suggests no consistent morphometric variation exists between ferrets found in association with different prairie dog species.

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The second section comprises five contributions dealing with ferret habitat—historic habitat, the status and characteristics of the Meeteetse area, and methods for locating and measuring potential habitat for reintroductions. The Flath and Clark paper gives a description of ferret habitat—prairie dogs—prior to large-scale alteration of the landscape by early Montana settlers. Their paper describes prairie dog distributions between 1908 and 1914, just prior to the 1915 U.S. Biological Survey efforts to destroy the prairie dog. It shows extensive prairie dog colonies, which today have been nearly eliminated (90+%). It is clear that habitat loss is the single most significant factor in ferret endangerment. The next paper by Clark et al. gives a description and history of the Meeteetse ferret environment. It shows that ferrets have occurred in the region for at least 100 years.

Currently ferrets occupy about 2,995 ha of white-tailed prairie dog (*C. leucurus*) colonies that are owned in equal portions by private, state, and federal interests. Many abandoned prairie dog colonies in the immediate area, scattered over large cattle ranches, along with the currently live colonies, total about 8,400 ha. It is believed that the extensive 1930s prairie dog poisoning programs destroyed many of these. The next paper, by Collins and Lichvar, describes vegetation on selected portions of Meeteetse ferret habitat and compares it with vegetation on prairie dog colonies elsewhere in Wyoming that historically provided ferret habitat. The authors conclude that all sites measured were previously disturbed by heavy livestock grazing or other factors and that vegetation is not a useful attribute to define ferret habitat or to locate transplant sites.

Fagerstone and Biggins describe prairie dog populations at Meeteetse serving as prey for ferrets and present a method to census prairie dogs as a means to locate ferret transplant sites. The last paper about ferret habitat by Houston et al. describes a habitat model—a habitat suitability index—useful in locating and comparing transplant sites. It suggests that year-round ferret requirements can be met in prairie dog colonies providing that: (1) prairie dog colonies are large enough, (2) burrows are numerous enough, and (3) adequate numbers of prairie dogs and alternate prey

exist. Five variables are defined and a method to compare prairie dog colony complexes to each other and to Meeteetse is presented.

The third group of papers address ferret behavior, activity patterns, and methods to locate additional ferrets. The Clark et al. paper on descriptive ethology and activity patterns describes an initial ethogram based on observations of 237 ferrets on 441 occasions (208 hrs). Ferrets were active at extremely cold temperatures ( $-39^{\circ}\text{C}$ ), in rain, snow, and winds to 50 kph. The next paper by Biggins et al. details activity patterns, based on radio tagging, of an adult male and a juvenile female in the fall. Both animals were primarily nocturnal. Peak activity was in early morning hours. The female averaged 1.9 hrs per night above ground (moving 76% and stationary 24%). The last paper in this section by Johnson et al. examines the use of thin-layer chromatography to identify scats to species origin. Twenty known ferret scats were compared with 72 unknown scats. This method was not useful, and analysis with gas-liquid chromatography may prove more definitive.

The two papers in the fourth group discuss the genetic viability of the Meeteetse ferrets and minimum viable population sizes. Kilpatrick et al. found no genetic variation in three proteins examined from saliva samples from 22 ferrets. Comparative data is so limited that it is currently impossible to provide a meaningful interpretation of the lack of genetic variation, but it is similar to results from other carnivore studies and populations that have undergone genetic "bottlenecks." The Groves and Clark paper examines five basic methods of determining the minimum viable population size needed for ferrets: (1) experiments, (2) biogeographic patterns, (3) theoretical models, (4) simulation models, and (5) genetic considerations. The genetic examination proved most useful, resulting in a minimum viable population estimate of about 200 ferrets for maintenance of short-term fitness.

In the fifth section, two papers deal with management and recovery of ferrets. Clark gives management guidelines for the Meeteetse ferrets, describing a series of needed monitoring and protection actions. Comparative data is listed for these actions as well as the public support and organizational ar-